

CLAIMS

WHAT IS CLAIMED IS:

1. In a video signal processing system, a method of computing a motion decision value, which comprises the following steps:

5 inputting a video signal with an interlaced video sequence of fields;

computing a frame difference signal from a difference between a previous field and a next field in the video sequence;

10 forming a point-wise motion detection signal from the frame difference signal;

computing a region-wise motion detection signal from the point-wise motion detection signal and an adjacent point-wise motion detection signal delayed by one field; and

15 forming from the region-wise motion detection signal a motion decision value and outputting the motion decision value for further processing in the video signal processing system.

2. The method according to claim 1, which further comprises low-pass filtering the difference signal prior to the step of forming the point-wise motion detection signal.

3. The method according to claim 2, wherein the step of low-pass filtering is defined by a low pass filter matrix

$$W_{M \times N} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1N} \\ w_{21} & w_{22} & \cdots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{M1} & w_{M2} & \cdots & w_{MN} \end{bmatrix}$$

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where w_{11}, \dots, w_{MN} represent a set of predetermined coefficients.

4. The method according to claim 1, wherein the step of forming the point-wise motion detection signal comprises computing

$$f_n(i, h) = T_K(d_n(i, h))$$

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where f_n is the point-wise motion detection signal, i and h define a spatial location of the respective video signal value in a cartesian matrix, $T_K(\cdot)$ denotes a threshold

10 function represented as

$$T_k(y) = \begin{cases} 1, & \text{if } y \geq K \\ 0, & \text{otherwise} \end{cases}$$

in which K is a positive constant, and $d_n()$ is the low-
 15 pass filtered frame difference signal.

5. The method according to claim 1, wherein the region-
 wise motion detection signal is computed from the point-wise
 motion detection signal by logically combining the point-wise
 motion detection signal f_n as

$$\phi_n(i, h) = f_n(i, h) \parallel f_{n-1}(i-1, h) \parallel f_{n-1}(i+1, h)$$

where $f_{n-1}(\cdot)$ denotes the motion detection signal delayed
 by one field, the indices i and h define a spatial location
 10 of the respective video signal value in a cartesian matrix,
 and the notation \parallel denotes a logical OR operation.

6. The method according to claim 1, which further
 comprises low-pass filtering the region-wise motion detection
 signal prior to the outputting step.

7. The method according to claim 6, wherein the region-
 wise motion detection signal is low-pass filtered to form the
 motion decision value $m_n(i, h)$ by:

$$m_n(i, h) = \sum_{p=-a}^b \sum_{q=-c}^d \phi_n(i + 2 \times p, h + 2 \times q) \cdot \alpha_{p,q}$$

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where $a, b, c, d \geq 0$, and $\alpha_{p,q}$ represents a set of normalized predetermined coefficients of a low pass filter.

8. The method according to claim 7, which comprises defining a kernel of the low pass filter as

$$[\alpha_{p,q}] = \begin{bmatrix} 0 & 1/8 & 0 \\ 1/8 & 4/8 & 1/8 \\ 0 & 1/8 & 0 \end{bmatrix}.$$

9. In a method of processing interlaced video signals, which comprises:

spatially interpolating a value of the video signal at a given location from a video signal of at least one adjacent location in a given video field;

temporally interpolating the value of the video signal at the given location from a video signal at the same location in temporally adjacent video fields; and

forming a motion decision value for the same location in accordance with claim 1; and

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mixing an output signal for the video signal at the
given location from the spatially interpolated signal
and the temporally interpolated signal and weighting the
output signal in accordance with the motion decision
15 value.

10. The method according to claim 9, which comprises
varying the motion decision value between 0 and 1 as a
function of an estimate of the degree of motion at the given
location and, upon estimating a high degree of motion,
5 heavily weighting the output signal towards the spatially
interpolated signal and, upon estimating a low degree of
motion, heavily weighting the output signal towards the
temporally interpolated signal.

11. The method according to claim 10, which comprises
outputting the spatially interpolated signal as the output
signal upon estimating a high degree of motion, and
outputting the temporally interpolated signal as the output
5 signal upon estimating a low degree of motion.

12. In a video signal processing system, an apparatus
for computing a motion decision value, comprising:

an input for receiving a video signal with an
interlaced video sequence;

5 difference forming means connected to said input
for computing a frame difference signal from a
difference between a previous field and a next field of
a current field to be deinterlaced;

means for forming a point-wise motion detection
10 signal from the frame difference signal, and for
computing a region-wise motion detection signal from the
point-wise motion detection signal and an adjacent
point-wise motion detection signal delayed by one field;
and

15 means for forming from the region-wise motion
detection signal a motion decision value and for
outputting the motion decision value for further
processing in the video signal processing system.

13. The apparatus according to claim 12, which further
comprises a low-pass filter connected to said difference
forming means.

14. The apparatus according to claim 13, wherein said
low-pass filter is programmed with a low pass filter matrix

$$W_{M \times N} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1N} \\ w_{21} & w_{22} & \cdots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{M1} & w_{M2} & \cdots & w_{MN} \end{bmatrix}$$

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where w_{11}, \dots, w_{MN} represent a set of predetermined coefficients.

15. The apparatus according to claim 12, which comprises a logic member programmed to compute the motion decision value from the point-wise motion detection signal by logically combining the point-wise motion detection signal f_n

5 as

$$\phi_n(i, h) = f_n(i, h) \parallel f_{n-1}(i-1, h) \parallel f_{n-1}(i+1, h)$$

where $f_{n-1}(\cdot)$ denotes the motion detection signal delayed
10 by one field, the indices i and h define a spatial location of the respective video signal value in a cartesian matrix, and the notation \parallel denotes a logical OR operation.

16. The apparatus according to claim 12, which further comprises a low-pass filter connected to an output of said outputting means.

17. The apparatus according to claim 16, wherein said low-pass filter is programmed to filter the region-wise motion detection signal to form the motion decision value $m_n(i, h)$ by:

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$$m_n(i, h) = \sum_{p=-a}^b \sum_{q=-c}^d \phi_n(i + 2 \times p, h + 2 \times q) \cdot \alpha_{p,q}$$

where $a, b, c, d \geq 0$, and $\alpha_{p,q}$ represents a set of normalized predetermined coefficients of said low pass filter.

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18. The apparatus according to claim 17, wherein said low-pass filter is defined with a kernel

$$[\alpha_{p,q}] = \begin{bmatrix} 0 & 1/8 & 0 \\ 1/8 & 4/8 & 1/8 \\ 0 & 1/8 & 0 \end{bmatrix}.$$

19. An apparatus of processing interlaced video signals, which comprises:

an input for receiving a video signal with an interlaced video sequence of fields;

5 a spatial interpolator connected to said input and configured to spatially interpolate a value of the video

signal at a given location from a video signal of at least one adjacent location in a given video field;

10 a temporal interpolator connected to said input in parallel with said spatial interpolator for temporally interpolating the value of the video signal at the given location from a video signal at the same location in temporally adjacent video fields; and

15 a computing apparatus according to claim 12 connected to said input and in parallel with said spatial interpolator and said temporal interpolator for forming a motion decision value for the same location; and

20 a mixer connected to receive an output signal from each of said spatial interpolator, said temporal interpolator, and said computing apparatus, said mixer being configured to mix an output signal for the video signal at the given location from the spatially interpolated signal and the temporally interpolated
25 signal in dependence on the motion decision value output by said computing apparatus.

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